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On the validity of some fossil species of *Liriodendron*.

THEO. HOLM.

WITH PLATE XXIII.

The making of species of fossil plants has been increasing rapidly during the last few years, and many new species have been recorded from this country. It seems, however, when we study the various articles that have been published upon the subject, as though there were a rivalry to see who could establish the largest possible number of species. Whether or not this is true, American paleobotanists are certainly going too far in giving incomplete and insignificant leaf-fragments specific names. Any botanist who studies our existing flora can not avoid observing the great variation that exists in the foliage of our trees and herbs; and must admit that it would be very difficult to refer all these leaf-forms to their respective species if they had been detached from their branches. Another fact that makes the study of paleobotany still more difficult is the usual absence of flowers and fruits. The identification of even the most completely preserved leaf must, therefore, be more or less uncertain, and when we consider fragments of such leaves, which do not show anything but a few veins and no very pronounced outline, we can only say that the identification becomes a mere guess, not only wholly worthless for scientific purposes, but often very misleading.

A careful study of the recent flora is, therefore, absolutely necessary, when it is desired to identify fossil leaves with even an approximate degree of correctness. The plant must be studied as it stands amidst the surroundings to which it has adapted itself, and which its leaves reflect, as we have learned from the excellent illustrations by Sachs¹, Wiesner², and Stahl³.

But it would really seem as if our paleobotanists ignore these facts, and consider their fossil leaves only as dead matter

¹Sachs, Julius: Die Anisotropie der Pflanzenorgane. Vorlesungen über Pflanzen-Physiologie 855. 1882.

²Wiesner, Jul.: Untersuchungen über den Einfluss der Lage auf die Gestalt der Pflanzenorgane. Sitzungsber. d. kais. Akad. d. Wiss., math.-naturw. Classe 101: 657-705. 1892.

³Stahl, E.: Regenfall und Blattgestalt, ein Beitrag zur Pflanzenbiologie. Ann. du Jardin Bot. de Buitenzorg 11: 98-182. 1893.

without signs of ever having lived. Some peculiar species have been made in this way, and it is our intention to give a few illustrations of supposed relationships existing between some fossil forms and the living species of our tulip-tree.

One of the most striking characters of the *Liriodendron* leaf is of course the notched apex in connection with the broad, more or less deeply lobed blade. We have already shown⁴ that leaves of seedlings and those at the base and apex of branches of mature trees are often oblong or obcordate without any lobation, and yet they still possess the characteristic notch at the apex. This last form, the approximately obcordate, reminds one very much of the leaflets of certain Leguminosæ, and such leaves, when found in a fossil state, are generally referred to *Leguminosites* or to *Liriodendron*. With very few exceptions we believe that such forms do not belong to *Liriodendron*, at least if we compare the illustrations given of the fossils with the leaves of our recent species. Mr. Arthur Hollick in a recent paper⁵ figures and describes several oblong leaves with notched apices as representing *Liriodendron simplex* Newb. Some of these leaves are very well preserved and show the outline and venation very distinctly, so distinctly in fact, that it may easily be seen that they are very different from leaves of *Liriodendron* as we understand the genus from the living species. We have copied one of Mr. Hollick's figures on the accompanying plate XXIII, fig. 3, and we have added two forms of similar small leaves of our living species for comparison (figs. 1 and 2.). Considering the mere outline of the leaves here brought together, we notice at once the disproportionate length of the fossil species, and the open sinus or notch at the apex of the recent form in connection with its long and slender petiole. It is not known whether the fossil leaves had any petiole; they appear rather to have been nearly sessile. The venation also is different, the living showing but few secondary veins, the fossil on the contrary numerous ones which together with the tertiary veins form a reticulate venation. So far therefore these fossil leaves show no evidence whatever of any relationship to the genus *Liriodendron*.

⁴Holm, Theodor: Notes on the leaves of *Liriodendron*. Proceedings U. S. National Museum 13: 15-35. *pl.* 4-9. 1890.

⁵Hollick, Arthur: Preliminary contribution to our knowledge of the Cretaceous formation on Long Island and eastward. Transact. New York Acad. Sci. 12: 222-237. *pl.* 5-7. 1893.

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We have stated above that such unlobed, notched leaves in many cases remind us of the leaflets of several Leguminosæ, and if we compare Mr. Hollick's figure 2 on his plate v (l. c.) where three leaves of the same size, shape and venation as our fig. 3, which is one of them, are figured, might we then not assume that they have been situated close together as they were found in the rock? They seem indeed to have formed a *trifoliate leaf*, not unlike *Desmodium*, *Phaseolus*, and others. Their venation is much more like that of the Leguminosæ than of any known *Liriodendron*. Moreover we must not forget that notched leaves are not only common among the Leguminosæ, but exist in many genera of various families, e. g., *Zygophyllum*, *Passiflora*, *Akebia*, etc., which might also be taken into consideration.

We see from this comparison that it is very unsafe to refer such leaves to *Liriodendron*, when such essential points as the petiole and the venation are imperfect or wanting. It is furthermore difficult to understand how Mr. Hollick could find any probable relationship between the small fragments figured on his plate 179⁶, and the genus *Liriodendron*. These fragments might just as well have been referred to genera of entirely different families and if not, we do not see why his leaf of *Colutea* (l. c.) figured on our plate as no. 5, has not been identified as a *Liriodendron* or *Liriophyllum*, in accordance with the other species mentioned above.

There is now another point to which we should like to call attention, viz., what Mr. Hollick calls the wing-like appendages on the petioles of *Liriodendron* "*alatum*."⁷ It seems to be taken for granted that this fossil form is also a representative of our tulip tree. Mr. Hollick's drawings are so large that we have only had space enough to figure one of these fragments, fig. 4, on our plate XXIII. He figures one nearly complete leaf with a wide notch at the apex and a winged petiole. Also the base of a blade with a similarly winged petiole (figured on our plate) and finally the upper part of a blade with a very narrow notch, unlike that of a typical leaf of *Liriodendron*. The winged petiole appears to have been no obstruction to Mr. Hollick's identification, the notched

⁶Hollick, Arthur: Additions to the paleobotany of the Cretaceous formation on Long Island. Bull. Torrey Bot. Club **21**: 49-65. pl. 174-180. 1894.

⁷Hollick, Arthur: Wing-like appendages on the petioles of *Liriophyllum populoides* Lesq., and *Liriodendron alatum* Newb., with description of the latter. Bull. Torrey Bot. Club **21**: 467-471. pl. 220-221. 1894.

apex eliminating all doubt of kinship in spite of the fact that the venation does not agree with that of our type. This species, *L. alatum*, was described by Dr. Newberry, but not published. Mr. Hollick in accepting the identification considers it from the point of view of a modern evolutionist. He sees nothing wrong in attributing adnate stipules to this genus; on the contrary he claims it to be a leaf-form "exceedingly interesting and significant." Taking "the standpoint of the evolutionist" he compares the leaf with *Platanus basilobata*, figured and named by Professor Lester F. Ward.⁸

The fact that *Liriodendron* and *Platanus* are genera with entirely different biological peculiarities is overlooked. Mr. Hollick even goes so far as to state that "it is reasonable to attribute similar origin to the conspicuous but fugacious stipules on the young saplings and shoots of *Liriodendron*." It would appear that Mr. Hollick does not know that the stipules are free in all the leaves of our tulip-tree, not only on the saplings but on all the branches from seedlings to mature trees. And this view, says Mr. Hollick, is "of course greatly strengthened by the discovery of the fossil species now under consideration." Professor Ward has figured some leaf-fragments of a supposed *Platanus*, and he compares these with our recent species, *P. occidentalis*, in which a basal lobation of the blade may sometimes be observed. But we have no proof whatever that these fragments of *Platanus basilobata* really belonged to any true *Platanus*, and Nathorst,⁹ one of the ablest of European paleobotanists, considers their identification as incorrect. The French botanist Godron¹⁰ and later Sir John Lubbock¹¹ have described the stipules of *Liriodendron* and explained how the leaf becomes notched. Godron figures the shape of the leaf while still enclosed in the bud, the bud scales being the stipules themselves. The entire leaf bends over when it is in bud, and the notch is the result of the fact that the apex of the blade rests in a furrow formed by the axis and one of the stipules.

Any one who has studied veneration in its various forms will

⁸ Ward, Lester F.: The paleontologic history of the genus *Platanus*. *Proceed. U. S. National Museum* 11: 39-42. *pl.* 17-22. 1888.

⁹ Nathorst, A. G.: Review of "Types of the Laramie Flora by Lester F. Ward." *Neues Jahrbuch für Mineralogie* 2: 219-222. 1893.

¹⁰ Godron, A.: Observations sur les bourgeons et sur les feuilles du *Liriodendron Tulipifera*. *Bull. de la Soc. Bot. de France* 8: —. 1861.

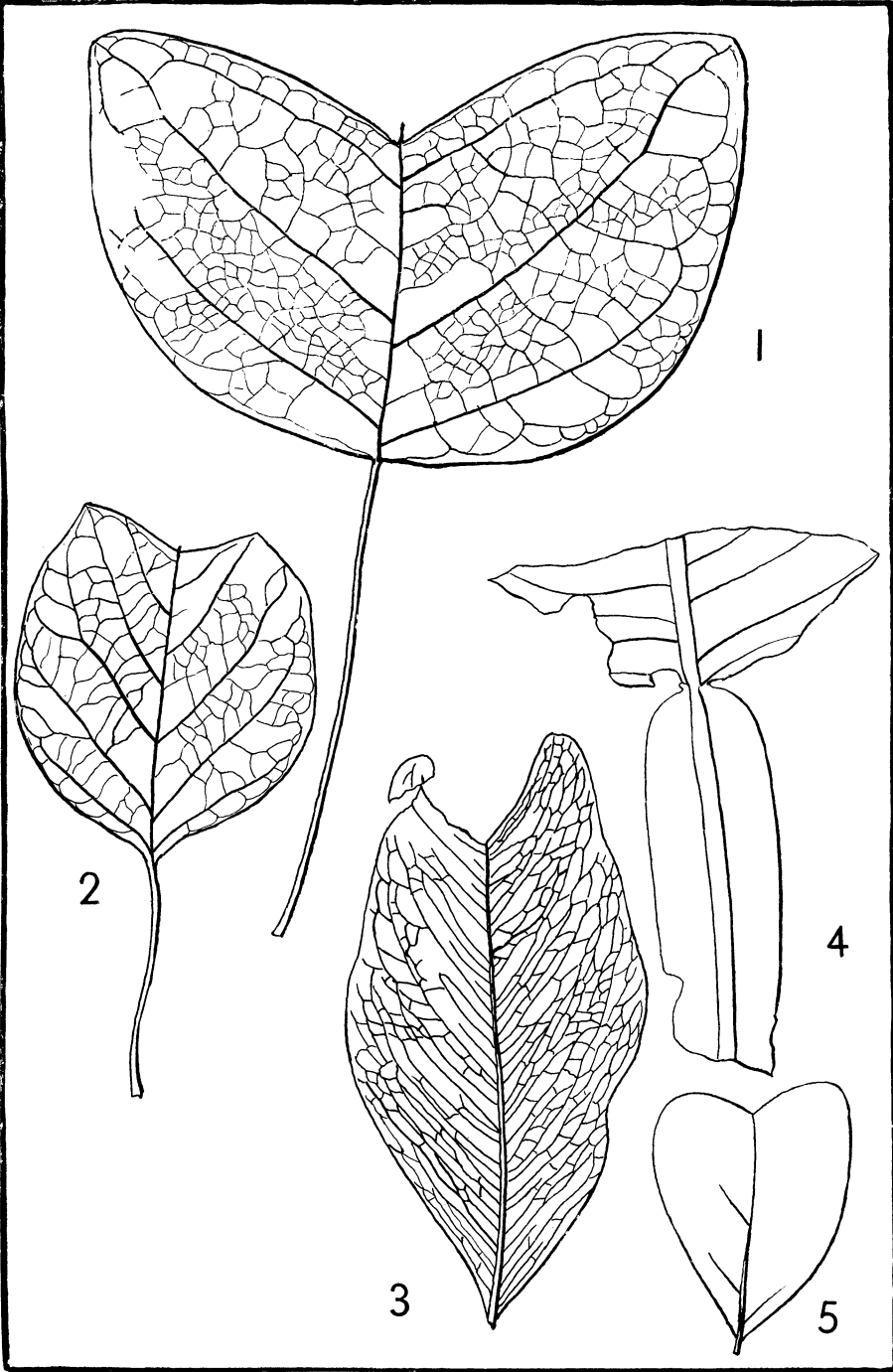
¹¹ Lubbock, Sir John: Phytobiological observations. *Journ. Linn. Soc.* 22 and 24: —. 1887.

appreciate the fact that the *Liriodendron* leaf could not possibly assume the position it does in the bud if the stipules were not free. If we now consider Mr. Hollick's figure of *L. alatum*, it is easily understood that this leaf could not show such veneration as our tulip-tree. The winged petiole would not allow any considerable curvature and the leaf-blade would meet no obstacle to the development of its apex. The notch of this leaf, *L. alatum*, if it is natural and not due to accidental injury or defective preservation, must depend on entirely different causes. It may be for the same reason that so many leaves have a more or less emarginate apex. Why this is we can not explain. One thing is evident, however, that Mr. Hollick's explanation is altogether too superficial to convince one that the ancestors of the tulip-tree had adnate stipules. If we consider his leaves as belonging to *Liriodendron*, we must suppose the apex to have been acute, that the notch was not natural to the leaf, and finally that the venation was entirely different from our recent type. We must express the same opinion as to Mr. Hollick's comparison of *Liriodendron alatum* with *Liriophyllum populoides*, viz.: that they were closely related on account of their adnate stipules and notched apex. It may be so, but to say the least the chances are quite as strong the other way, and in all probability none of these leaves have ever had anything to do with ancestral forms of *Liriodendron*.

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EXPLANATION OF PLATE XXIII.

Figs. 1 and 2. Leaves of *Liriodendron Tulipifera* drawn from nature, natural size.—Fig. 3. *Liriodendron simplex* Newb. (copied).—Fig. 4. *Liriodendron alatum* Newb. (copied).—Fig. 5. *Colutea primordialis* Heer (copied).



HOLM on LIRIODENDRON.